5.28 Underway geophysics

5.28.1 Sea surface gravity

(1) Personnel (*: Leg-1, **: Leg-2, ***: Leg-1+2)

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Souichiro SUEYOSHI***	(GODI)	- Operation Leader (Leg-1 and 2)
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Ryo KIMURA*	(GODI)	
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(2) Introduction

The local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface.

(3) Parameters

Relative Gravity [CU: Counter Unit]

[mGal] = (coef1: 0.9946) * [CU]

(4) Data Acquisition

We measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (Micro-G LaCoste, LLC) during the MR11-07 cruise from 25th September to 1st December 2011.

To convert the relative gravity to absolute one, we measured gravity, using portable gravity meter (CG-5, Scintrex), at Sekinehama before departure, and will measure after MR11-08, as the reference point.

(5) Preliminary Results

Absolute gravity will be calculated on February 2012, going back to Sekinehama port.

(6) Data Archives

Surface gravity data obtained during this cruise will be submitted to the Data Management Group (DMG) of JAMSTEC, and will be archived there.

(7) Remarks (Times in UTC)

1) The observation was carried out within following periods,
Leg1: 12:00 25th Sep. 2011 to 23:59 25th Oct. 2011.
Leg2: 00:00 29th Oct. 2011 to 03:00 1st Dec. 2011.

2) Spring tension value jumped by about 350CU due to sensor trouble on 16th November.

5.28.2 Sea surface three-component magnetometer

(1) Personnel

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(2) Introduction

Measurement of magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during the MR11-07 cruise from 25th September 2011 to 1st December 2011.

(3) Principle of ship-board geomagnetic vector measurement

The relation between a magnetic-field vector observed on-board, **H**ob, (in the ship's fixed coordinate system) and the geomagnetic field vector, **F**, (in the Earth's fixed coordinate system) is expressed as:

$$\mathbf{H}ob = \tilde{\mathbf{A}}\ \tilde{\mathbf{R}}\ \tilde{\mathbf{P}}\ \tilde{\mathbf{Y}}\ \mathbf{F} + \mathbf{H}p \qquad \text{(a)}$$

where $\tilde{\mathbf{R}}$, $\tilde{\mathbf{P}}$ and $\tilde{\mathbf{Y}}$ are the matrices of rotation due to roll, pitch and heading of a ship, respectively. $\tilde{\mathbf{A}}$ is a 3 x 3 matrix which represents magnetic susceptibility of the ship, and **H**p is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Eq. (a) makes

$$\tilde{\mathbf{B}}\mathbf{H}ob + \mathbf{H}bp = \tilde{\mathbf{R}}\ \tilde{\mathbf{P}}\ \tilde{\mathbf{Y}}\ \mathbf{F} \qquad \text{(b)}$$

where $\tilde{\mathbf{B}} = \tilde{\mathbf{A}}^{-1}$, and $\mathbf{H}bp = -\tilde{\mathbf{B}}\mathbf{H}p$. The magnetic field, **F**, can be obtained by measuring $\tilde{\mathbf{R}}$, $\tilde{\mathbf{P}}$, $\tilde{\mathbf{Y}}$ and **H**ob, if $\tilde{\mathbf{B}}$ and **H**bp are known. Twelve constants in $\tilde{\mathbf{B}}$ and **H**bp can be determined by measuring variation of **H**ob with $\tilde{\mathbf{R}}$, $\tilde{\mathbf{P}}$ and $\tilde{\mathbf{Y}}$ at a place where the geomagnetic field, **F**, is known.

(4) Instruments on R/V MIRAI

A shipboard three-component magnetometer system (Tierra Tecnica SFG1214) is equipped on-board R/V MIRAI. Three-axes flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs from the sensors are digitized by a 20-bit A/D converter (1 nT/LSB), and sampled at 8 times per second. Ship's heading, pitch, and roll are measured by the Inertial Navigation System (INS) for controlling attitude of a Doppler radar. Ship's position (GPS) and speed data are taken from LAN every second.

(5) Data Archives

These data obtained in this cruise will be submitted to the Data Management Group (DMG) of JAMSTEC.

(6) Remarks (Times in UTC)

1) The observation was carried out within following periods,
   Leg1: 12:00 25th Sep. 2011 to 23:59 25th Oct. 2011.
   Leg2: 00:00 29th Oct. 2011 to 03:00 1st Dec. 2011.

2) For calibration of the ship's magnetic effect, we made a "figure-eight" turn (a pair of clockwise and anti-clockwise rotation). This calibration was carried out as below.

01:32 29th Sep. 2011 to 01:59 29th Sep. 2011 (05-08S, 78-23E)

21:58 30th Oct. 2011 to 22:22 30th Oct. 2011 (08-00S, 80-30E)

5.28.3 Swath Bathymetry

(1) Personnel

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Wataru TOKUNAGA	(MIRAI Crew)	

(2) Introduction

R/V MIRAI equipped with a Multi narrow Beam Echo Sounding system (MBES), SEABEAM 2112 (SeaBeam Instruments Inc.). The objective of MBES is collecting continuous bathymetric data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(3) Data Acquisition

The "SEABEAM 2112" on R/V MIRAI was used for bathymetry mapping during the MR11-07 cruise from 25th September to 1st December 2011.

To get accurate sound velocity of water column for ray-path correction of acoustic multibeam, we used Surface Sound Velocimeter (SSV) data to get the sea surface (6.2m) sound velocity, and the deeper depth sound velocity profiles were calculated by temperature and salinity profiles from CTD or XCTD or ARGO data by the equation in Del Grosso (1974) during the cruise.

Table 5.28.3-1 shows system configuration and performance of SEABEAM 2112.004 system.

Table 5.28.3-1 System configuration and performance

SEABEAM 2112 (12 kHz system)	
Frequency:	12 kHz
Transmit beam width:	2 degree
Transmit power:	20 kW
Transmit pulse length:	3 to 20 msec.
Depth range:	100 to 11,000 m
Beam spacing:	1 degree athwart ship
Swath width:	150 degree (max) 120 degree to 4,500 m 100 degree to 6,000 m 90 degree to 11,000 m
Depth accuracy:	Within < 0.5% of depth or +/-1m, whichever is greater, over the entire swath. (Nadir beam has greater accuracy; typically within < 0.2% of depth or +/-1m, whichever is greater)

(4) Preliminary Results

The results will be published after primary processing.

(5) Data Archives

Bathymetric data obtained during this cruise will be submitted to the Data Management Group (DMG) of JAMSTEC, and will be archived there.

(6) Remarks (Times in UTC)

The observation was carried out within following periods,

Leg1: 12:05 25th Sep. 2011 to 11:12 30th Sep. 2011
06:35 24th Sep. 2011 to 00:07 26th Oct. 2011

Leg2: 23:59 28th Oct. 2011 to 22:19 30th Oct. 2011
07:24 28th Nov. 2011 to 03:00 1st Dec. 2011